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ABSTRACT

The primary aim of this study was to explore ways in which educational planners could improve resource allocation to increase both the quantity and quality of education in Colombia. Technological and operational innovations were sought for improving literacy training, vocational and agricultural education, and teacher training. Since only three months were allocated for this pilot effort, the research concentrated on the advantages that could be provided by the use of educational television for the primary school system. The study found that if educational television is to be really effective, it must be introduced into a system that has not only a good foundation of qualified teachers and administrators, but adequate educational facilities. As a result of this effort the feasibility and need for additional research in this area was revealed. (Author/AWW)

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MAY 1968

PLANNING EDUCATIONAL CHANGE FOR THE PRIMARY SCHOOLS OF COLOMBIA: A BRIEFING

H. S. Dordick

PREPARED FOR:
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The RAND Corporation
SANTA MONICA • CALIFORNIA

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PREFACE

This Memorandum comprises the modified text of a briefing that was presented to members of the Offices of Technical Cooperation and Research and Program Coordination of US/AID, Washington, D.C., during the week of August 14 - 18, 1967. The briefing is largely based upon a forthcoming RAND Memorandum on education in Colombia.

This briefing presents the results and findings of a three-month pilot study undertaken to explore ways in which educational planners of Colombia and US/AID could improve both the quantity and quality of education in Colombia. Several innovations for educational improvements were examined; however, because of the limited time allocated for this pilot effort, research was concentrated on the advantages that could be provided by the use of educational television for the Colombian primary-school system.

Perhaps the most important results of this effort were that it revealed the feasibility and need for additional research in this area and provided a basis for ongoing and future inquiry. The work showed the usefulness of systematic analysis of education even though data are incomplete, and that despite raising questions not adequately answered to date, such studies can expose key relationships and sensitivities that are of importance to educational planners in developing countries.

It must be recognized that the study reported here is a preliminary investigation, limited by both time constraints and the unavailability at RAND of extensive or reliable data. Moreover, since this is primarily an exercise in methodology, we must emphasize that it is <u>not</u> intended to be used as a basis for policy decisions. Nevertheless, this briefing is being made available as a RAND Memorandum because of the current interest in education for developing countries and in educational television.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to M. B. Carpenter, L. G. Chesler, and S. A. Haggart, who are the coauthors of the larger study upon which this briefing is based; to L. L. Johnson, Jo Ann Lockett, J. D. Mallett, and J. G. Root for their helpful participation in the investigation that led to this briefing; and to Janet Murphy for her assistance in the preparation of this publication.

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I. PURPOSE OF THE STUDY

The primary aim of this study was to explore ways in which educational planners of Colombia and US/AID could improve resource allocation to increase both the quantity and quality of education in Colombia. We examined the Colombian education system, seeking both technological and operational innovations for improving literacy training, vocational and agricultural education, and teacher training. Within the limited time allocated for this pilot effort, however, the research concentrated on the advantages that could be provided by the use of educational television (ETV) for the primary-school system.

The feasibility of using ETV depends greatly, of course, on the availability of a useful communication system--it is hardly reasonable to expect that the educational demand alone ought to pay for a country's communication and television system. It was, therefore, necessary to determine the present status of communications in Colombia, to consider the future possibilities, and to examine the ways in which education can take advantage of developments in communications technology.

No attempt was made in this study to predict educational requirements. Rather, objectives spanning a wide range, from nominal improvements on the status quo to achieving marked increases in quality and quantity, were examined. The quantity and quality goals examined appear relevant to Colombia's problems, and the methodology developed is applicable to other goals selected by educational planners. Our intent has been to provide insights into desirable courses of action for the planners by describing relevant options for attaining these goals, examining critical factors of these options, and estimating costs and their sensitivities to the critical factors.

Throughout this brief study, we were limited by inadequate data sources in the United States, and we did not have the opportunity to visit Colombia. We, therefore, elected to study only those aspects for which data were available and for which it was not necessary to make any assumptions that could not be substantiated. Thus we have omitted some rather obvious operational options--for example, the working-while-studying programs which have been quite successful in our society but

which, to our knowledge, have never been used in Colombia. No such programs have been mentioned in any of the Colombian planning documents available to us (except those dealing with vocational on-the-job training).

We did not have the time to explore the political, economic, or cultural stumbling blocks to implementation. But since we avoided policy options and educational designs that appeared to be outside recent Colombian experience, we feel that our conclusions are valid for present-day Colombia.

II. QUANTIFYING EDUCATIONAL OBJECTIVES

We established two educational objectives for Colombia that we were able to quantify without too many qualifying assumptions: (1) to increase the availability of primary education and (2) to improve the quality of this education.

INCREASING THE AVAILABILITY OF PRIMARY EDUCATION

We considered the primary-school population to be made up of children between 7 and 14 years of age. This is, admittedly, a wide grouping; but it is realistic because many children in Colombia start school at the age of 7, drop out for a year or more, and then return. It frequently happens that at the completion of their primary education they will be 14 years of age or older.

We chose 1962 (a year for which good data are available) as the base year for this examination. In 1962 there were about 3.6 million Colombians between the ages of 7 and 14 (Chart 1), of which about 1.95 million were estimated to be enrolled in primary schools. About 300,000 of these students were enrolled in the private schools, which are financed by both private and government funds. About 25 percent of the primary schools in the urban areas are private schools; there are essentially no private schools in the rural areas.

The estimated enrollment of 1.95 million represents 54 percent of those eligible for primary education. However, Colombian enrollment figures are taken on the first day of school, and up to 35 percent of the students drop out before the first year is completed.* We estimate, therefore, that the average yearly enrollment in primary school is much closer to 35 percent of the eligible students.

We considered 1969 to be the earliest that decisions for change could be implemented, and we selected 1975 as the target year for which the results of different programs would be examined. By 1975, there

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*Bangnee Alfred Liu, Estimating Future School Enrollment in Developing Countries--A Manual of Methodology, UNESCO, 1966.

POPULATION AND PRIMARY-SCHOOL ENROLLMENT
(Thousands)

	1962	1975
POPULATION BETWEEN 7 AND 14	3,600	5,200
PRIMARY-SCHOOL ENROLLMENT	1,949	3,500
PERCENT ENROLLED (First day of school)	54%	67%

Chart 1

will be, we estimate, about 5.2 million children of primary-school age.* Using the first day's enrollment figures as an indication of the demand for primary education in Colombia--which has shown considerable growth over the last ten years, first-day enrollment rising from about 38 percent in 1954 to 54 percent in 1962--we extrapolated linearly to 1975 and estimated that between 65 and 70 percent of the primary-school-age

*This estimate is based on the population growth rate of 3.2 percent per year indicated by the 1951 and 1964 censuses, reported in Some Aspects of Population Growth in Colombia, Economic Commission for Latin America, United Nations Economic and Social Council, November 10, 1962, and Censo Nacional de Poblacion, 15 de Julio de 1964, Departamento Administrativo Nacional de Estadistica, DANE, October 1965.

group will seek education. At an average of about 67 percent, there is a potential enrollment of 3.5 million students. This increase of from 54 to 67 percent appears modest, but in reality we are assuming an increase in the availability of primary-school facilities of better than 80 percent--from an actual 38 percent enrollment to 67 percent.

There are two policy alternatives that the Colombian planner might consider with respect to his investments in primary education. He could maintain the same ratio of public and private schools as now exists, thus allocating the same percentage of students to private schools in 1975 as exists now. Or he could emphasize the public sector by expanding enrollment at the expense of the private sector. It is conceivable that there may be little or no choice if the policy and technological options considered here are implemented, since they will most likely need to be financed by US/AID funds, and public monies from the United States will certainly be focused on the public sector. However, there is very little difference between the facility requirements for each of these alternatives: If the present public/private ratio is maintained, facilities will have to be provided for about 3 million primary-school children in 1975; if the public sector is emphasized, facilities will be needed for close to 3.1 million.

IMPROVING THE QUALITY OF PRIMARY EDUCATION

The second objective--improving the quality of education--is more difficult to quantify, since it is very difficult to measure the quality of teaching. However, it is reasonable to assume that a formally qualified teacher can provide better instruction than an unqualified teacher.* In 1962, of the approximately 40,000 teachers in the public-school system of Colombia, half were qualified and half unqualified.**

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*The terms "qualified" and "unqualified," as used throughout this Memorandum, are defined on p. 6.

**Alejandro Bernal Escobar, et al., La Educación en Colombia, Centro de Investigaciones Sociales, Departamento Socio-económico, Oficina Internacional de Investigaciones, Sociales de FRERES, Lovaina (Belgica) y Bogotá (Colombia), 1965.

The Colombians define a qualified teacher as one who has had five years of primary education in either an urban or a rural school, four years of secondary education in a normal school, and a two-year professional training cycle. The Colombians also consider a teacher qualified for the rural area if he has completed the five-year primary program (in either a rural or urban school) and has had a four-year training program in a rural normal school. It is possible to become qualified as a "second-level teacher" by completing a secondary program of six years plus a four-year university training program.

An unqualified teacher is one who has, for one reason or another, dropped out of the formal training system described above and has therefore not been "accredited." There are people throughout the rural areas, for example, who have had only five years (or even less) of primary-school education, but who are permitted to teach because they can read and write better than their students. Estimates made in 1962 show that roughly 80 percent of the teachers in the urban areas are qualified, while only about 23 percent of those in the rural areas are qualified.*

By 1975, a total of 85,000 public-school teachers will be required in Colombia, assuming that facilities are provided for 3.1 million primary-school children.** The goal for this study was that essentially all of these teachers be qualified (Chart 2).

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*Escobar, et al., op. cit.

**In 1962 the average student/teacher ratio for all schools was 36.9/1, but for the public schools alone it was about 41/1. (Escobar, et al., op. cit.) We assumed that by 1975 it would be desirable for the public schools to at least approach the low student/teacher ratio of the private schools; therefore, we have based our calculations on a ratio of 37/1.

NUMBERS OF TEACHERS
(Public Education)

	DATA FOR 1962	OBJECTIVE FOR 1975
TOTAL TEACHERS	40,000	85,000
QUALIFIED	20,000	85,000
UNQUALIFIED	20,000	0

Chart 2

III. PLANNING OPTIONS

There are several operational and technological options open to educational planners for both increasing the opportunity for education and improving its quality. Educational technologies range from the use of radios to computer-aided teaching systems and of course include ETV.

There are numerous options for increasing student and teacher training, including special summer sessions for students who must work on farms, evening sessions for students as well as teachers, on-the-job training, working while learning, and correspondence schools. But we elected to consider only those options that were relevant to Colombian policy and life and that therefore had some promise of being implemented. Several, indeed, have been proposed by the Colombians themselves.

We selected the following major planning options (Chart 3):

1. A minimal program, using present educational techniques and standards
2. Improving the quality of teaching, using conventional, non-technological means
3. Improving the quality of teaching by greater use of ETV

In the first option, the present ratio of public/private-school enrollment is maintained, the private schools growing in proportion to the public-school system. In the last two options, the public sector is assumed to be emphasized so that public schools will have a greater percentage of the enrollments. However, in any case, our cost estimates and analysis include only the public-school system within each option.

For all but the minimal-program option, we found that school consolidation is a prerequisite for other improvements, since the present school system provides clearly inadequate facilities and therefore generally offers little incentive for either students or teachers.

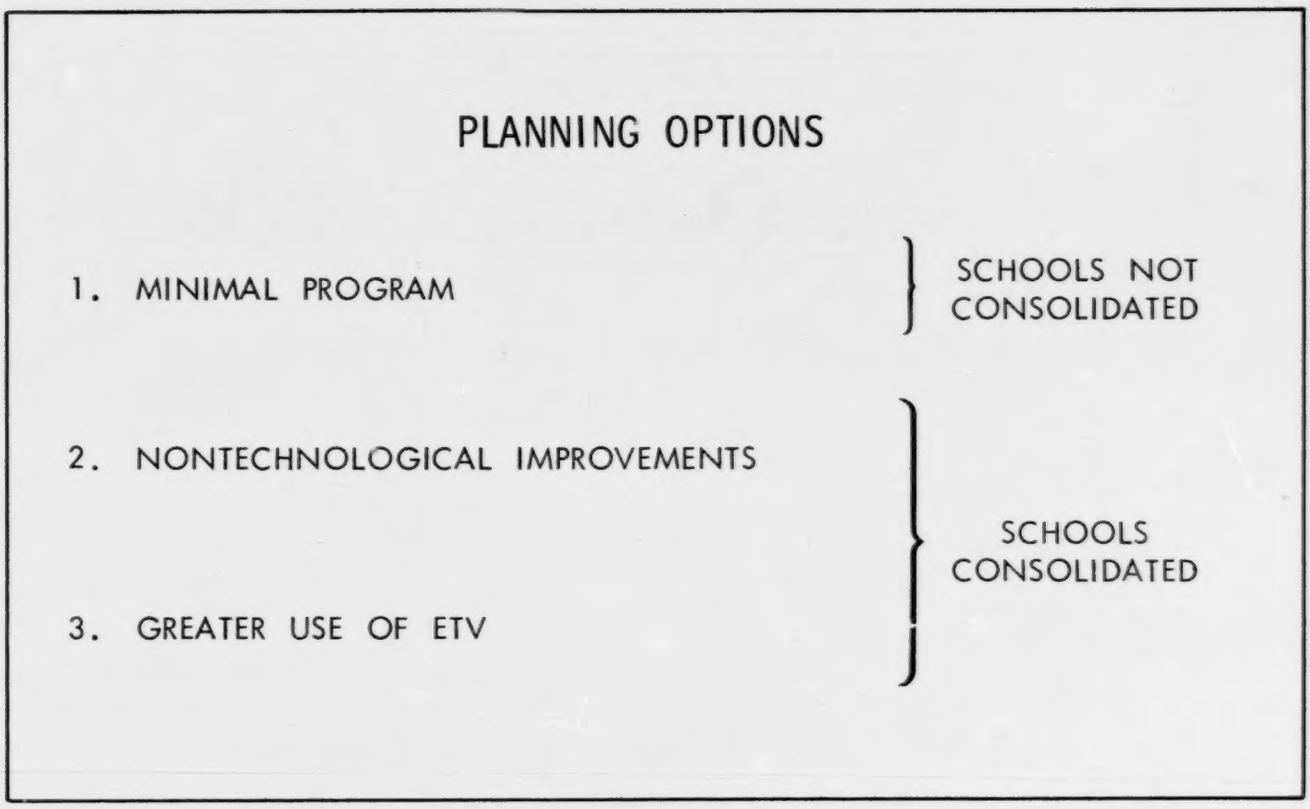

Chart 3

Schools in Colombia--particularly in rural areas--are often used inefficiently. There are many schools with only two grades and, say, 50 students, but these still require two teachers, a principal teacher and an administrator. When the number of students is limited, Colombian rural schools generally offer fewer grades, rather than attempting to cover all grades, as is done in the "little red schoolhouses" in the United States. In 1962, there were 15,000 schools in the rural areas of Colombia, with an average of two classrooms (i.e., two grades) per school*; there were 4500 urban schools with an average of five one-grade classrooms each (Chart 4).

In general, then, the rural children can at best obtain only a two-grade primary education unless they move into an urban area that has a schoolhouse with five or more grades. With the bleak prospect

*Escobar, et al., op. cit.

PUBLIC-SCHOOL FACILITIES — 1962

	URBAN	RURAL
NUMBER OF SCHOOLS	4,500	15,000
AVERAGE NUMBER OF CLASSROOMS PER SCHOOL	5	2

Chart 4

of only a two-year education and the frequent economic necessity for children to work, it is not surprising that as many as 94 percent of the Colombian primary-school children drop out of school between the first and fifth grades.*

The two-classroom schools may also contribute to teacher drop-out, since many teachers probably want to work among and with other teachers, which is virtually impossible in a small rural school. It would appear that consolidation might be profitable in the rural areas for providing more effective, multigrade schools. For these reasons, we included consolidation in Chart 3 as a component of some of the planning options.

Distance and mountainous terrain can discourage parents from sending their children to school if the school is too far from home. Therefore, we based our criterion for consolidation on the distance a child

*Escobar, et al., op. cit.

could walk to and from school, which we assumed to be two miles. Population density studies showed that roughly 50 percent of the so-called rural areas could be consolidated, if this two-mile criterion is used. In other words, 50 percent of the areas had sufficient population within a two-mile radius to include at least 120 children, enough students to justify a five-grade school.

A school-consolidation program based on this criterion would lead to the construction of many more five-grade schoolhouses, some of which would have ten to twenty rooms. Under this program, by 1975 (Chart 5) there would be an additional 840 five-room schools, 2540 ten-room schools, and 715 twenty-room schools in the urban areas. But in the rural areas, which include the relatively unpopulated sectors in the

CONSOLIDATED SCHOOLS FOR 1975

	URBAN	RURAL
2-ROOM	—	22,300
5-ROOM	5,340	910
10-ROOM	2,540	—
20-ROOM	715	—

Chart 5

East, there would still be about 22,300 two-room, two-grade schools. Construction of larger schools to achieve economies of scale and to better utilize ETV has been urged for some time by the Peace Corps and AID.* But the Colombian response has been slow, partly because of geographical problems and poor transportation, and also, undoubtedly, for political reasons. Although the education budget is national, it is administered by the states, and the amount an area receives is based on the number of schools in the area.

THE MINIMAL PROGRAM

It is very important to consider the consequences of maintaining the present standards and techniques in Colombian education; that is, the minimal program. Our definition of this program addresses the question, What would it cost the Minister of Education to do essentially nothing--just keep his head above water and maintain the kind of instruction now being given, with the kinds of teachers now available, making no major improvements except by classical means? This minimal program pretty much follows the current plans of the Education Ministry in Colombia and includes US/AID plans for the country.** The school-construction program would be similar to the current program, providing for the building of larger schools but not necessarily involving consolidation. Many more two-room schoolhouses would be built in both urban and rural areas, despite the possibility that this may discourage rather than encourage school attendance. Teacher salaries would not be altered; thus the teacher turnover and teacher migration to larger urban centers would continue unabated. (We assumed a teacher-turnover rate of 15 percent, which is twice that in the United States; the 15 percent is a weighted average derived from an urban rate of 12

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*George Comstock and Nathan Maccoby, The Peace Corps Educational Television Project in Colombia, Two Years of Research, Research Report No. 1, "The Project as a Whole--Organization, Adaptation, and Expansion," Institute for Communication Research, Stanford University, November 1966.

**Country Assistance Program, Colombia, Agency for International Development, November 1963.

percent and a rural rate of 24 percent.*) There would be a continued very critical shortage of qualified teachers and an increase in the use of unqualified teachers in both the rural and urban areas. (This projected situation is based, of course, on the assumed increase in student enrollment.)

Teacher production would continue at present rates, since no changes would be made in the method of teacher training. Escobar, Liu, and others have indicated that at best only 12 percent of the teacher-training graduates actually enter the profession, and we have assumed that this percentage will be the same in 1975.

IMPROVEMENT BY CONVENTIONAL, NONTECHNOLOGICAL MEANS

If the program of school consolidation discussed earlier is instituted, the requirement that all teachers be qualified can be met using conventional means--just getting teachers into the educational system as it now stands--and also through the use of an intensive one-year training program.

Recently, Colombian administrators stated that there are many people throughout the Colombian economy who have attended a secondary school with the objective of getting a university education but have never quite finished. The Colombians argue that it would be well worthwhile to offer these people an intensive one-year training program (equivalent to the two-year training program for teachers) which would enable them to become qualified teachers.**

We can only guess at the reasons for the lack of qualified teachers in Colombia. We do not know why teachers drop out of the profession, nor do we know exactly why prospective teachers fail to complete training courses they have enrolled in. However, as we mentioned earlier, the two-grade, two-room schoolhouses may contribute to teacher dropout. Also, there is relatively little incentive to stay in a profession

*Escobar, et al., op. cit.; Liu, op. cit.; H. Lyman, et al., U.S. Army Handbook for Colombia, Foreign Areas Studies Division, Department of the Army, July 1961.

**Country Assistance Program.

where the salaries are not competitive with other opportunities for people with even slightly above-average schooling. The prestige of teaching, which was once high in Colombia, appears to have decreased over the years, probably due to the relatively low salary scales and the occasional failure on the part of departmental governments to meet their teachers' payroll on schedule.

Therefore, under this option, teachers' salaries would be increased by an average of 25 percent to make them more competitive with industrial and business salaries. We have assumed that this increase would reduce teacher turnover to about 8 percent.* To make up for the shortage of qualified teachers, the Colombian-generated option of the one-year special training program would also be implemented.

USE OF ETV AND ASSOCIATE TEACHERS

Colombia has one of the world's largest programs of instructional television. In 1967, over 275,000 pupils in over 800 schools were receiving 40 televised lessons per week.** But of late the program has not been expanding at the expected rate. The reasons for this slowdown are not clear, but they probably include the government's doubts about the feasibility of using ETV for the entire primary-school curriculum and the costs of expansion.

However, our analysis has indicated that the most effective option for improving the quantity and quality of Colombian education may involve the extensive use of television in the schools, along with some training of presently unqualified teachers in the techniques of teaching with television. As in the preceding option, a rather formidable consolidated-school construction program would be required, and teachers' salaries would be raised. Each grade would receive three full hours of

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*This is approximately the teacher-turnover rate in the United States. This rate represents a "best" case and can be looked upon as a desired objective.

**New Educational Media in Action, Case Studies for Planners, Vol. 2, UNESCO, International Institute for Educational Planning, Paris, 1967.

televised lessons per day--roughly three times the present ETV practice in Colombia. An additional television channel would be put into operation, and television sets would be provided to the schools (three sets for each five grades*; six sets for each ten rooms; and up to twelve sets in a twenty-classroom school). Set maintenance would also be included. The programming preparation for the production of the lessons would also be provided, along with the printed material that must be used with the lessons.

Finally, this option includes the use of what we have called associate teachers. The large numbers of unqualified teachers now teaching in Colombia could become associate teachers by taking an intensive three-month training program in the use of television in the classroom. This program could be given during the summer months (a practice quite common in Colombia but frequently ineffectively used because under current salary scales, teachers are forced to work at other jobs during school vacations).

We are making a critical assumption: that an unqualified teacher with television as an aid is better than an unqualified teacher without television. This is not to say that an associate teacher is the equivalent of a qualified teacher with or without television; however, we do assume that associate teachers would be more effective than unqualified teachers without television. Experience shows that while ETV cannot be a direct substitute for good-quality teaching, it can be quite effective if properly utilized by an associate teacher.** Studies in American Samoa and Colombia (the latter by a Stanford University group evaluating the effectiveness of the Peace Corps)*** have indicated that a teacher using television appears to become a better teacher, even for those courses in which television is not being used. In

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*At present, there is one set for each five grades.

**See, for example, Wilbur Schramm, et al., The New Media: Memo to an Educational Planner, International Institute for Educational Planning, UNESCO, Paris, 1966.

***Comstock and Maccoby, op. cit.

American Samoa, there is also some evidence that students being taught by television perform better than control-group students receiving only face-to-face teaching.*

As another example, some 12,000 children in North Carolina took part in a TV-teaching experiment in 1958-59. From this experiment, the Educational Testing Service concluded that "TV instruction in the North Carolina experiment is, on balance, more effective than conventional (face-to-face) instruction."** These and other experiments reinforce our conclusions about the value of ETV, especially for areas where no other means is available for giving adequate education to large numbers of children.

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*Clifford H. Block, Report on the Samoan Educational Television System, Agency for International Development, 1965.

**Research in Instructional Television and Film, Summaries of Studies by J. Christopher Reid and Donald W. MacLennan, University of Missouri, a publication of the U.S. Department of Health, Education, and Welfare, U.S. Government Printing Office, Washington, D. C., 1967, p. 142.

IV. COMMUNICATIONS TECHNOLOGY IN COLOMBIA

The use of ETV in Colombia is dependent on the communications facilities there; we examined the present status of Colombian communications and the potential for growth over the next several years. Communications systems and facilities are influenced by the geography and population distribution of the country. The western part of Colombia is mountainous, as this map shows (Chart 6); three mountain ranges run through it. Most of the eastern part of the country is jungle-covered, and less than 2 percent of the people live in this eastern area (Chart 7). Ninety-eight percent of the people live along the major mountain ranges, where the climate is more comfortable. Of this 98 percent, more than 16 percent live in the department of Cundinamarca, where Bogotá is located, and 9 percent live in Bogotá itself. Fourteen percent of the population live in Antioquia.

Taking into account these geographic factors and population patterns, we examined three specific means for providing additional television in Colombia: ground-based microwave facilities (improving and extending their current system), satellites, and airborne TV.

GROUND-BASED MICROWAVE FACILITIES

The Colombians take pride in the fact that their present television system, which uses ground-based microwave facilities, reaches 80 percent of the population (Chart 8). In the future, Colombian television will reach even more of the population, if the migration patterns of the people continue. The ratio of urban to rural population, which was 50/50 in 1962, will likely be 60/40 by 1970, and by 1975 almost 70 percent of the people will be living in urban areas along the mountains or in the major cities.*

There are two television networks in Colombia, both government-controlled, but only one is devoting time to educational broadcasts. The Colombians state that they can send a signal from a single transmitter in Bogota that will reach both the Pacific and the Caribbean.

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*By the Colombian definition, an area with a population of 2000 is considered to be an urban area, even if it does not have the electricity required for use of the ground-based microwave facilities.

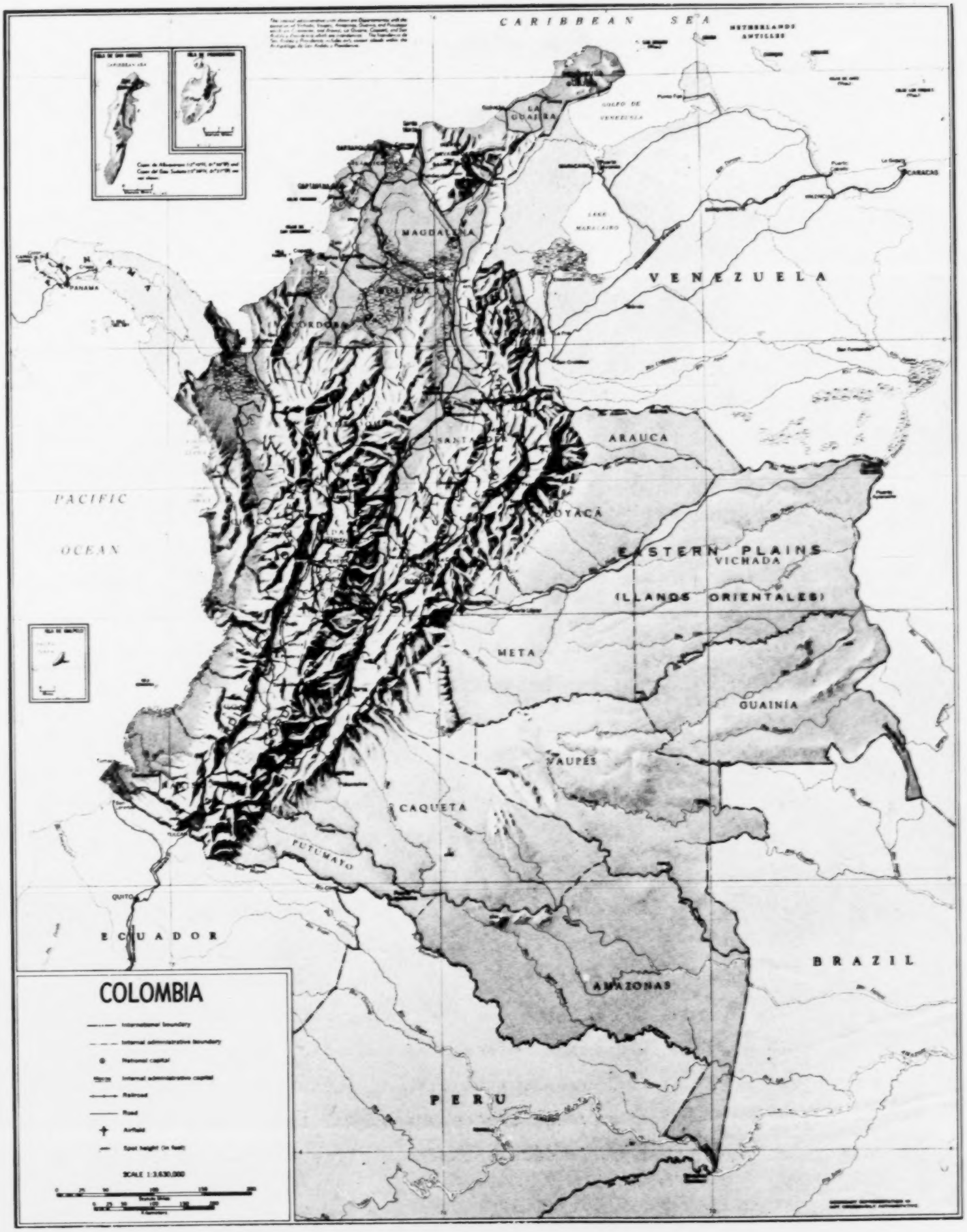

Chart 6—Geography of Colombia

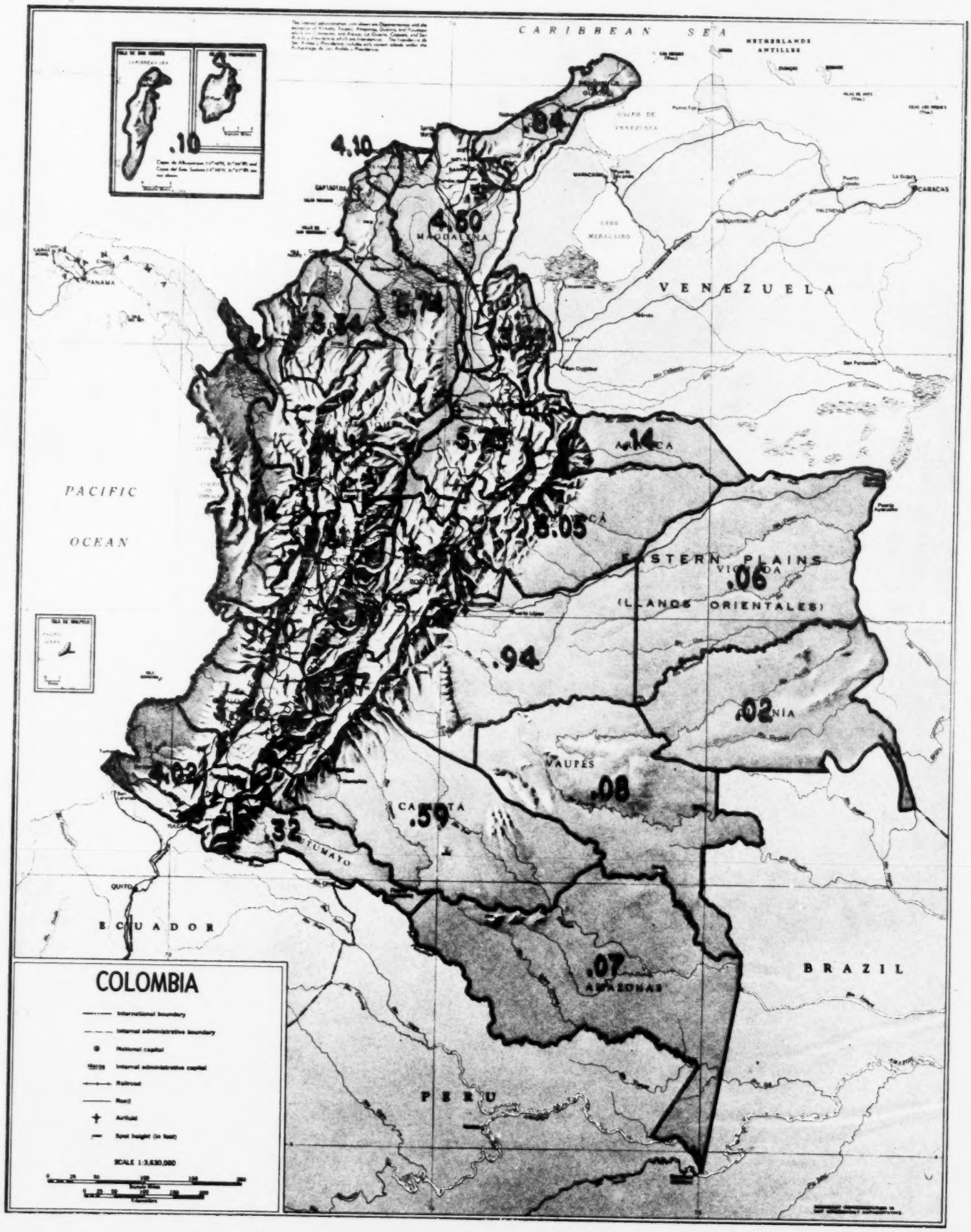

Chart 7—Population distribution in Colombia

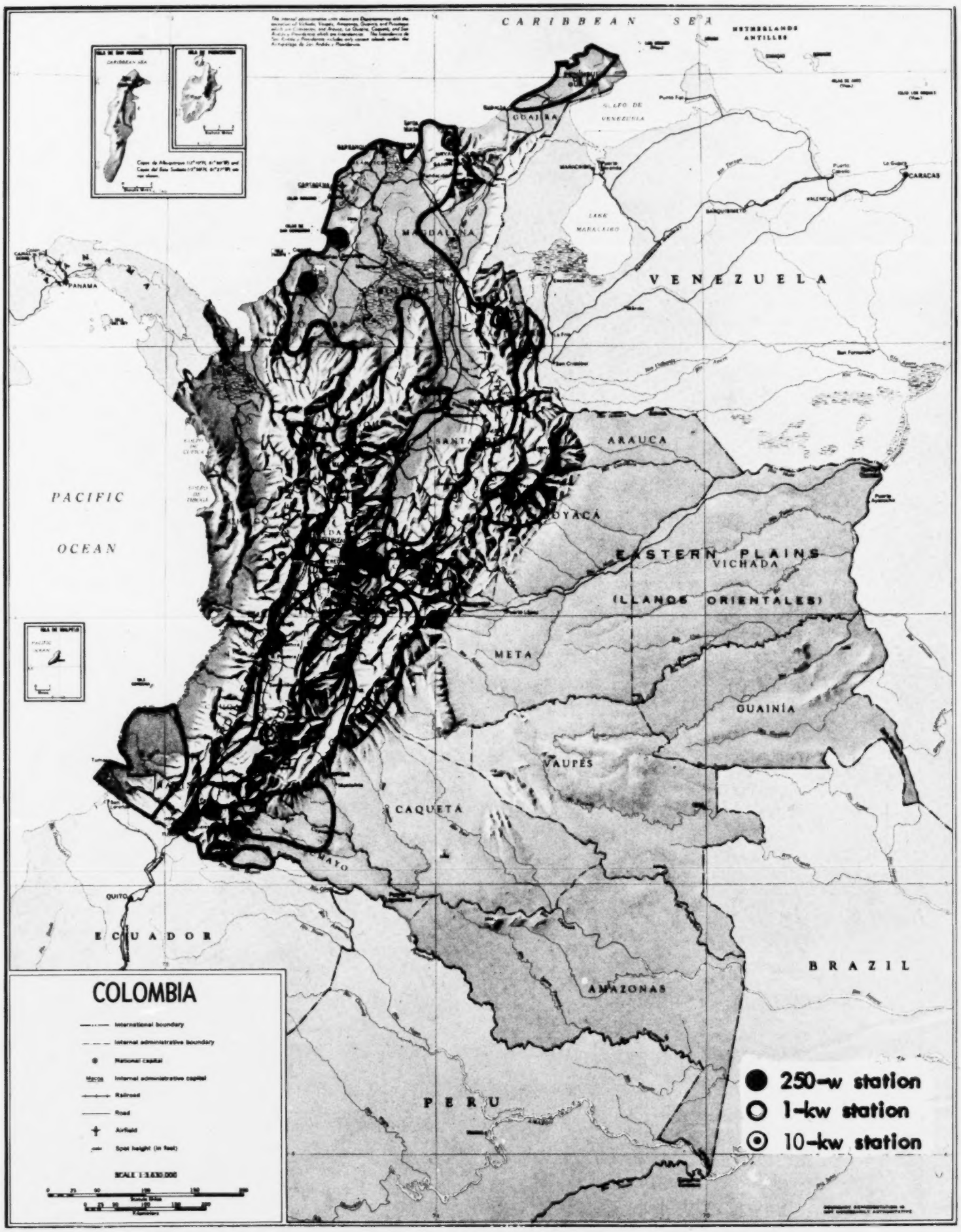

Chart 8—Television coverage in Colombia

This is plausible, since an antenna can be mounted in Bogotá at an altitude of almost 10,000 ft. We have not been able to determine the quality of this signal, but it is probably not uniform. Also, reception may frequently be quite poor, since most of the people live in the mountains, at altitudes of between 2000 and 7000 ft.

THE POTENTIAL OF SATELLITES

The role that satellites might play in television communication was of considerable interest to us. The population coverage offered by a satellite system would be at least equal to that of the improved ground-based microwave system; and once launched, the satellite can broadcast to the less-populated eastern areas of the country. But for this discussion we are concerned with providing ETV for the more densely populated mountain zones and with ways to increase the number of television channels.

We examined possible TV-satellite systems in order to make some estimate of when such a system could be available to the Colombians and to compare the cost of satellite systems with that of increasing the present microwave system. There are several kinds of TV-satellite systems that could be used. The Intelsat voice/data system, which is the current international COMSAT system, is available now (Chart 9). Within two years, a satellite broadcast system will exist that can transmit to a major broadcast distribution center (as is done in the United States), which will then rebroadcast to the various listeners. The ground-terminal stations can range in price from $50,000 to perhaps $500,000 each.* It is expected that in three to five years, satellite broadcasts will be sent directly to community centers. The satellites will transmit at greater effective radiated power to a community antenna system, rather than to a major broadcasting center. However, at present, there are very few local distribution stations in Colombia, and the major repeaters are located only in the few large cities. Therefore, a TV-satellite system that broadcasts directly to

*Samuel Gubin, "Direct Satellite Broadcasting," unpublished paper, Radio Corporation of America, 1967.

TV-SATELLITE SYSTEMS

APPLICATION	SATELLITE EFFECTIVE RADIATED POWER (dbw)	RECEIVER OR TERMINAL COST ($ thousands)	AVAILABILITY
INTELSAT VOICE/DATA	40	500 - 5,000	NOW
TV BROADCAST STATIONS	43	50 - 500	2 YRS
COMMUNITY TV	47	5 - 50	3 - 5 YRS
SCHOOL TV	53 - 56	0.7 - 5.0	7 - 15 YRS
HOME TV	68	0.1 - 1.0	10 - 15 YRS

Chart 9

antennas on top of the schools seems the most logical way to use satellites to make ETV available to children in all the communities of Colombia. The satellite effective radiated power for such a system would have to be increased by between 20 and 30 percent to achieve a reasonable receiver-terminal cost (about $700 to $5000). However, unless there is a crash program in the development of these satellites--that is, a program under which several hundred million dollars will be spent in developing and operating the system in the next few years--this type of broadcasting could probably not be available to Colombia in less than 7 to 15 years.

AIRBORNE TELEVISION

We gave some consideration to the use of airborne television for areas that are not reached by satellite or ground-based microwave systems because of the lack of ground stations. These areas include the rural zones on the fringes of the mountains and the eastern plains regions; the residents of these areas comprise essentially the 20 percent of the Colombian population that does not have television coverage (see p. 17).

In an airborne television system, an aircraft fully equipped to broadcast several hours of ETV programs over two channels circles the area to which it broadcasts for several hours per day. This is essentially the MPATI system that is currently being used in the midwestern United States and being considered for application in India and Turkey.

Colombia has a fairly extensive flying service, and it would be relatively easy to convert several aircraft into flying broadcast stations. Since the same ETV broadcast could be shown in different regions at different times merely by altering the flight pattern of the aircraft, both aircraft and program utilization could be very high. Flying at 23,000-ft altitudes, the aircraft can cover a 200-mile-radius circle, or about 150,000 square miles. The cost for two fully equipped aircraft, both capable of broadcasting two channels, would be about $4 million, and the annual operating cost would be about $1 million. The equipment could be made available immediately and could be shifted in accordance with need.

CONCLUSION

The expansion of ETV usage in Colombia will require not only a broader base of coverage but also an increase in the number of television channels, primarily within the heavily populated areas of the country. Since the Colombians have a microwave network that appears to be operating reasonably well, additional television channels could be added, we estimate, for a cost of not more than $10 million to $15 million per channel, which is considerably less than that required to mount a satellite, even if an ETV satellite could be utilized at this point. However, the important fact is that the microwave system

is available now. So, we conclude that the best way to expand the use of ETV in Colombia would be by means of their present microwave system. Nevertheless, we feel that the airborne television system might be very useful for the sparsely populated eastern areas.

V. COST ANALYSIS

What does all this mean in terms of investment and operating costs? And further, to what extent would the options discussed achieve the stated objectives of providing facilities for twice the present primary-school enrollment and of having all students taught by fully qualified or associate teachers?

The investment costs include the cost of building schools and supplying their utilities and the costs of supplying each additional student with books, paper, and so on. The recurring costs include teacher salaries, annual cost of replacement of facilities, and costs of furniture and equipment. The cost of training teachers for the minimal-program option would normally be charged to the existing secondary-school program, and since no new means of training would be instituted under this option, we have not included any training costs in our minimal-program calculations. The other planning options, however, would include incremental costs of teacher training, since changes would be made to the existing system. Hence, in all cases we are considering only those investment costs that are over and above present investment costs.* Unfortunately, we do not know what the current Colombian investment program is.** Certainly the yearly expenditure for education of $93 million in 1962 must include some investment in training new teachers and in school construction. It is probably impossible to determine the amount, because so many school buildings are rented, and because of the double use of rural buildings for many functions, the role of the army in constructing schools, and the use of church monies from local and international organizations for training and paying teachers.

Chart 10 shows our estimate of the six-year investment costs for each of the options we considered and the recurring costs to be expected in 1975.

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*We must assume that the government of Colombia is making some investments in education now. Although we did not have access to this information during this pilot study, the data are available in Bogotá.

**We do know that by Colombian Constitutional Amendment (1957), at least 10 percent of the national budget must go into public education.

COSTS OF PRIMARY EDUCATION

	INCREMENTAL COST ($ MILLIONS)	
	INVESTMENT, 1969 - 1975	RECURRING, BY 1975
MINIMAL PROGRAM	330	145
CONVENTIONAL IMPROVEMENTS	445	195
ETV	435	200

Chart 10

The important factor here is not the absolute dollar figures, but rather the comparison in the investment and recurring costs among the various options. You will note that if the Minister of Education does nothing more than he is doing now except to fulfill the quantity objective, he will need to make an investment of $330 million between 1969 and 1975. This represents the costs of providing additional school facilities and administrators, putting together curricula (including ETV programs) for the system now being used, and other educational activities.

To achieve the quantity and quality goals through traditional improvements--that is, by maintaining the current educational system but alleviating the tremendous teacher-dropout rate through salary increases and providing more qualified teachers through the use of one-year intensive training programs--will require an investment about 35 percent greater than that for the minimal program.

If ETV is used and both the quantity and quality objectives are achieved, the required investment is actually lower than that for the conventional-improvements option, and not a great deal higher than that for the minimal-program option. The operating costs are also much the same.

Omitting the minimal-program option, which will not achieve the objectives we have established, we find that estimates of investment and recurring costs alone provide very little basis for making a choice--the costs are not that different. Therefore, on what basis can the planner make a choice? Since an improvement is sought in both the quality and quantity of available primary education, the key decision factor is the availability of qualified or equivalently qualified (i.e., associate) teachers.

The numbers of students for whom qualified instruction would be available under the minimal-program and ETV options in 1969 and 1975 are shown in Chart 11. With present teacher-training programs, it will be impossible to achieve the teaching-quality objective within the six-year period 1969 to 1975. Indeed, qualified teachers will be available for less than one-third of the students.*

The numbers of teachers who would have to be trained in order to provide qualified instruction for all students by 1975 are shown in Chart 12. If nontechnological improvements only are made, an additional 75,000 qualified teachers will have to be trained. This will require that the qualified-teacher output be increased by 12,500 teachers per year, beginning in 1969. On the other hand, if ETV is used, only an additional 30,000 qualified teachers would have to be trained, or 5000 per year; 38,000 associate teachers would be used, and there would be no unqualified teachers.

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*Only about 30 percent of the almost 70,000 teachers that will be required in 1969 will be qualified. If the ratio of 1 teacher for every 37 students is maintained, about 725,000 students will be receiving qualified instruction. We estimate that 100,000 teachers will be required in 1975; at the present percentage of qualified teachers and the same student/teacher ratio, slightly over 1 million students will be receiving qualified instruction in 1975. (See Liu, op. cit.)

STUDENTS RECEIVING QUALIFIED INSTRUCTION
(Thousands)

	1969	1975
MINIMAL PROGRAM	725	1,021
ETV AND ASSOCIATE-TEACHERS PROGRAM	—	3,200

Chart 11

ADDITIONAL TEACHERS NEEDED TO BE TRAINED BY 1975
(Thousands)

	QUALIFIED	ASSOC.	UNQUALIFIED
CONVENTIONAL IMPROVEMENTS	75	-	0
ETV	30	38	0

Chart 12

VI. STUDY FINDINGS THUS FAR

At this point it is not possible to draw any firm conclusions about the most effective ways to improve education in the Colombian primary-school system. This pilot study was very brief, and no field visits were made. Nevertheless, I would like to discuss our findings briefly (Chart 13) and indicate the areas where further research appears warranted.

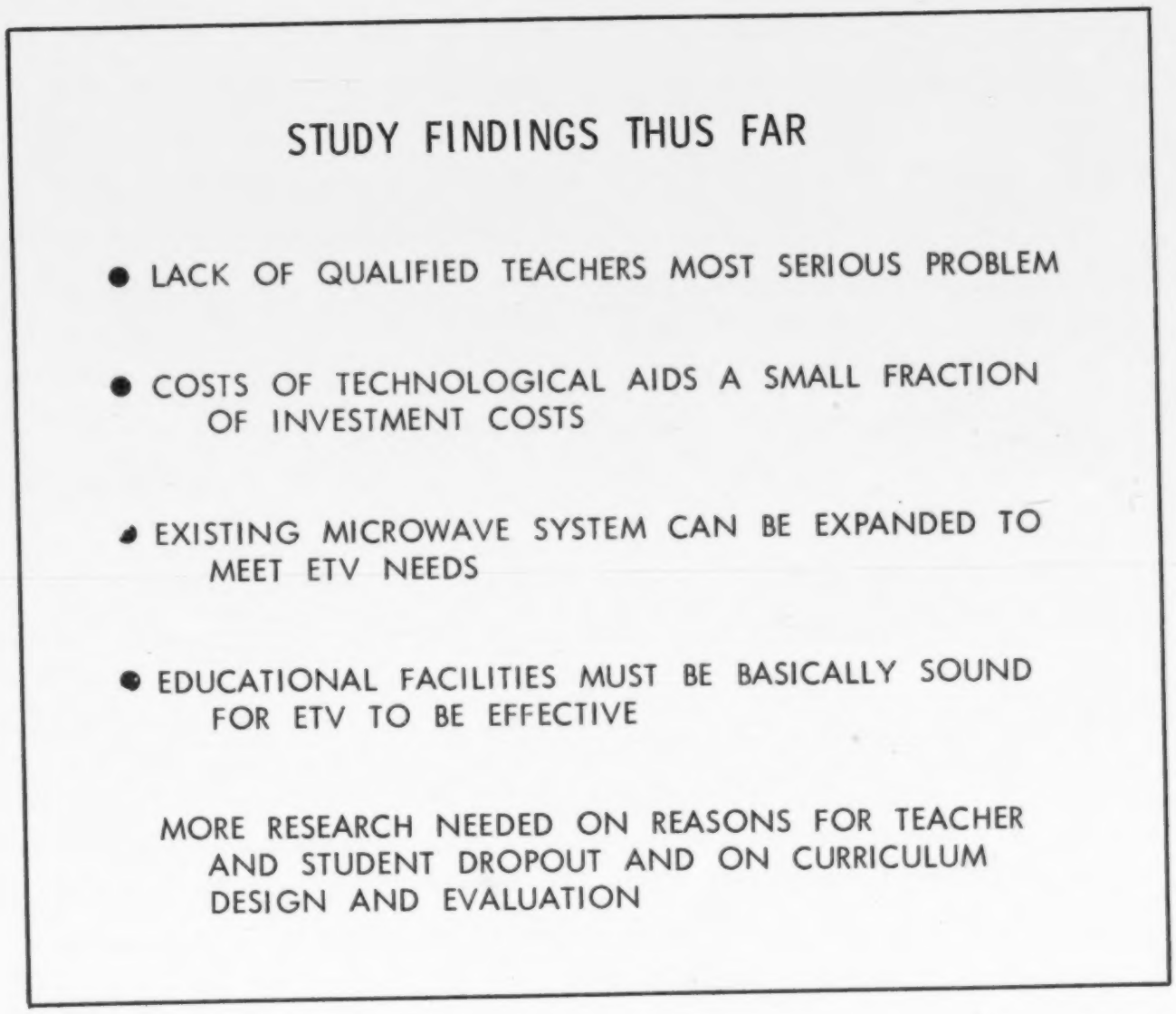
STUDY FINDINGS THUS FAR
• LACK OF QUALIFIED TEACHERS MOST SERIOUS PROBLEM
• COSTS OF TECHNOLOGICAL AIDS A SMALL FRACTION OF INVESTMENT COSTS
• EXISTING MICROWAVE SYSTEM CAN BE EXPANDED TO MEET ETV NEEDS
• EDUCATIONAL FACILITIES MUST BE BASICALLY SOUND FOR ETV TO BE EFFECTIVE
MORE RESEARCH NEEDED ON REASONS FOR TEACHER AND STUDENT DROPOUT AND ON CURRICULUM DESIGN AND EVALUATION

Chart 13

FINDINGS

The Need for Qualified Teachers

The greatest obstacle to quality education in Colombia is the lack of qualified teachers. With present training methods, if teachers are to be provided for the projected 1975 primary-school population, facilities will have to be made available for 80,000 teacher trainees, beginning in 1969. This is double the number for which facilities are now available. Colombia will have to make a total investment of 480,000 teacher-years of teacher training--80,000 teachers in training for six years--as shown in Chart 14. If Colombia expands its use of ETV but retains the requirement for a six-year training program, 180,000 teacher-years will have to be invested, and the number of teacher-training places will need to be increased by 50 percent. On the other hand, if they adopt their own suggestion of a one-year intensive training program and find candidates for this program, the investment is much more reasonable--80,000 teacher-years, or about 13,000 per year. Finally, if the use of associate teachers with ETV were introduced, the investment would be only 30,000 teacher-years, or about 5000 teachers in training per year. (In all cases we have assumed that the teacher-dropout rate will be reduced to almost half the present rate.) Without the use of ETV there is little chance that the required number of qualified teachers can be found within the next seven years.

Technology Costs

This analysis showed very clearly that the costs for technology do not constitute the major part of the investment required for improved education. Of the $435 million investment that would be required to provide ETV in all the primary schools, no more than $16 million, or less than 4 percent, would be spent on ETV technology, over the six-year period. Technology costs include the costs of improving the microwave network, associate-teacher training, program preparation, studio facilities (which must be doubled to take advantage of an additional TV channel), additional TV sets, and set maintenance and repair. The

TEACHER-TRAINING INVESTMENT FOR 1975
(Teacher - Years)

	6 - YEAR TRAINING	1 - YEAR TRAINING
CONVENTIONAL PROGRAM	480,000	80,000
ETV AND ASSOCIATE-TEACHERS PROGRAM	180,000	30,000

Chart 14

number of TV sets in the country would be more than tripled, which would allow for a 40 percent (or more) increase in ETV viewing time.

Most of the necessary investment, which is only about 35 percent more than would be required for the minimal-program option, would go into higher teachers' salaries, improved school facilities, and school administration--in short, the greater part of the investment would be spent in creating a well-founded and viable educational base.

Use of the Microwave System

The need for additional television channels in Colombia can be met most cost-effectively by expanding the existing microwave system. This finding is based upon the assumption that the present system is solid--that it has good transmitters, receivers, and repeaters.

Preconditions for Effective Use of ETV

Our brief study suggested strongly that if ETV is to be really effective, it must be introduced into a system that has not only a good foundation of qualified teachers and administrators but also good educational facilities. This is certainly evident in the fact that the investment required for the school plant itself is far greater than that for technology.

CRITICAL AREAS FOR ADDITIONAL RESEARCH

Teacher Dropout

Since the need for qualified teachers is the greatest obstacle to education in Colombia, the teacher-dropout rate is a very critical factor in Colombia's education problems. More study should be undertaken to determine whether increasing teachers' salaries will reduce the dropout rate (as we have assumed) or will have no effect on it at all.

Student Dropout

The issue of student dropout is critical for the educational planner. We can only speculate on the reasons for student dropout, at this point. However, if the students feel that the subjects taught are irrelevant to their lives, if they are bored with school, or if they have little incentive because the quality of education is poor, then any of the policy options suggested here might help to reduce the student-dropout rate. On the other hand, if the student drops out of school because of economic reasons, then perhaps none of these techniques would be very valuable. In these cases, it might be worthwhile to subsidize the parents so that they could keep the children in school. Another possibility would be starting the children in school at a much earlier age--say at four--as was done in the U.S. Project Headstart, so that by the time a child is ten and has to contribute to the economy of his family, he will at least have had six years of primary education.

Curriculum Design and Evaluation

More must be learned about curricula in Colombia and about the design of courses that are relevant to the economic and social needs of the Colombians. Also, since a substantial percentage (about 13 percent in 1967) of the primary-school children are already receiving a large portion of their education via television, it is essential that a system be designed soon for evaluating the effectiveness of ETV.